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EXAMINER
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MADDEN, GREGORY VINCENT

ART UNIT	PAPER NUMBER
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2622

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/20/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

# Office Action Summary

Application No.

10/603,796

Applicant(s)

MOULI, CHANDRA

Examiner

Gregory V. Madden

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 02 February 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-30,32-36 and 38-40 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-30,32-36 and 38-40 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 June 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Response to Arguments***

Applicant's arguments (see Amendment after Non-Final Office Action, filed February 2, 2007) with respect to the rejection(s) of claim(s) 1, 8-11, 30, 32-34, 36, and 38-40 under 102(e) in view of Takayama et al. (U.S. Pat. 6,683,643) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Harada (U.S. Pat. 7,133,072) in view of Bakhle et al. (U.S. Pat. 6,061,092), as well as Harada (U.S. Pat. 7,133,072) in view of Bakhle et al. (U.S. Pat. 6,061,092) further in view of Takayama et al. (U.S. Pat. 6,683,643). Claims 6, 7, 14, 15, 20-24, and 35 are rejected over Harada (U.S. Pat. 7,133,072) in view of Bakhle et al. (U.S. Pat. 6,061,092) further in view of Houchin et al. (U.S. Pat. 5,047,861), while claims 16-19 and 25-29 are rejected over Harada (U.S. Pat. 7,133,072) in view of Bakhle et al. (U.S. Pat. 6,061,092) further in view of Houchin et al. (U.S. Pat. 5,047,861) still further in view of Baharav et al. (U.S. Pat. 6,737,625). Please refer to the new rejections to the remaining claims set forth below.

Beginning on Pg. 18 of the Remarks, the Applicant submits that the capturing and storing of defective pixels having white or black flaws is not equivalent to the capturing and storing of dark current reference images, as recited in claims 1, 8, 30; 33, 34, 36, and 38-40. The Examiner agrees with the Applicant's assertion, but believes that the Harada reference explicitly teaches the capturing and storing of dark current reference images (stored in dark correction memory 23), as will be discussed in further detail below.

Further, on Pg. 19 of the Remarks, the Applicant contends that the Bakhle system is dependent upon a host computer system and also relates to video cameras as opposed to still cameras, and therefore one of ordinary skill in the art would not have been motivated to incorporate the Bakhle system with a

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digital still camera system that does not rely upon a host computer system. However, while the primary embodiment of Bakhle does disclose using a host computer to conduct the image processing, Bakhle also suggests that such processing could be done within the camera, without the use of a host computer, as is taught in Col. 7, Lines 14-18. Also, while it is true that the Bakhle reference is drawn toward a digital video camera as opposed to a digital still camera, Bakhle performs the image processing on individual video frames, correcting each frame using a dark reference image, which is equivalent to correcting individual still images. With such individual frame correction, the Examiner believes that one of ordinary skill in the art would have been sufficiently motivated to combine the dark current image correction of Bakhle with a still camera correction processing system.

Finally, it is noted that the Applicant has canceled claims 31, 37, and 41. Please refer to the rejection to the remaining claims set forth below.

#### *Double Patenting*

Applicant is advised that should **claims 30 and 33** be found allowable, **claims 36 and 38** will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

#### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 1-4, 8-12, 30, 32, 33, 36, 38, and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harada (U.S. Pat. 7,133,072) in view of Bakhle et al. (U.S. Pat. 6,061,092).**

First, in regard to claim 1, the Harada reference teaches an image processing apparatus (engine 4) comprising a storage system for storing first data (sensed image data in memory 12) corresponding to at least one actual image and second data corresponding to at least one dark current reference image (stored in dark correction memory 23) captured by a pixel array (CMOS or CCD 1), and a processor (image correction circuit 5) coupled to the storage system for compensating the first data (sensed image data) using the second data (dark correction data), wherein the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the second data. Please refer 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. What the Harada reference fails to specifically teach is that the storage system stores a plurality of gain conditions and a plurality of exposure times associated with the first data and a plurality of gain conditions and a plurality of exposure times associated with the second data. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the storing of gain and exposure time settings for the first and second data data, as taught by Bakhle, with the compensation system of Harada. One would have been motivated to do so because by using a cache of previously stored dark reference images to compensate for actual images, a dark reference image does not need to be captured for each actual image in order to correct for dark current noise, etc., thereby reducing the shutter operations and power constraints, as taught by Bakhle in Col. 3, Lines 44-50.

Considering **claim 2**, the limitations of claim 1 are set forth above, and the Bakhle reference further teaches that the processor performs compensation using the second data (dark image data), having an associated gain and exposure time that most closely matches the gain and exposure time associated with the first data, as is taught in Col. 3, Line 40 – Col. 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54.

As for **claims 3**, the limitations of claim 2 are shown above, and Harada teaches that the processor (image correction circuit 5) performs both dark current and defective pixel compensation on the first data (sensed image data), as taught in Fig. 2 and Col. 4, Line 58 – Col. 5, Line 63.

Regarding **claim 4**, the limitations of claim 2 are set forth above, and the Bakhle reference further teaches that the pixel array (36) captures a plurality of dark current reference images (dark images) under a plurality of gain and exposure conditions, and the respective second data corresponding to the plurality of captured dark current reference images is stored along with the associated gain and exposure condition information (dark column reference data) for each dark current reference image in the storage system (cache 41). Again, please refer to Figs. 2-3, Col. 3, Line 40 – Col. 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54.

Next, considering **claim 8**, the Harada reference teaches a method for pixel compensation, wherein the method comprises capturing, using a pixel array (CMOS or CCD 1), first data (dark correction data) corresponding to dark current reference images, storing reference data corresponding to the dark current reference image in a storage system (dark correction memory 23 within engine 4), capturing, using a pixel array (1), at least one actual image (sensed image data), and storing the second data corresponding to the actual image in the storage system (memory 12), and compensating the second data (sensed image data) using the reference data (dark correction data). Please refer 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. While Harada does disclose that the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the first (reference) data, Harada fails to teach that that storage system stores a plurality of gain

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conditions and a plurality of exposure times associated with both the first and second data. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the storing of gain and exposure time settings for the first and second data, as taught by Bakhle, with the compensation method of Harada. One would have been motivated to do so because by using a cache of previously stored dark reference images to compensate for actual images, a dark reference image does not need to be captured for each actual image in order to correct for dark current noise, etc., thereby reducing the shutter operations and power constraints, as taught by Bakhle in Col. 3, Lines 44-50.

In regard to **claim 9**, the limitations of claim 8 are taught above, and the Bakhle reference teaches that the act of compensating is performed while the digital camera is in an idle state, as is taught in Col. 6, Lines 6-31.

As for **claim 10**, the limitations of claim 8 are shown above, and Harada also discloses that the act of compensating further comprises identifying pixels affected by dark current using the dark current reference data (stored in dark correction memory 23), compensating the second data at pixel locations using the reference data, and storing the compensated data in the storage system (12). Please refer to Figs. 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13.

Considering **claim 11**, the limitations of claim 8 are again taught above, and Harada also teaches that the method further comprises identifying pixels as defective pixels (in defect correction circuit 22) using the reference data, compensating the second data (data from dark correction circuit 21) at pixel locations using the reference data, and storing the compensated second data in the storage system (12).

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Again, please see Figs. 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13.

Regarding **claim 12**, the limitations of claim 8 are taught above, and the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a dark current reference image are also stored, wherein the gain and exposure time settings of the dark current reference images used in the compensation are those which most closely match the gain and exposure time settings of the first data (scene image) (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54).

Next, in regard to **claim 30**, Harada teaches a digital camera system comprising an image sensor (1), a dark current and defect pixel compensation circuit (5) for compensating first data corresponding to an actual image (sensed image data), and an image processor (CDS/AGC 2) coupled to the dark current and defective pixel compensation circuit (5) for forwarding the first data from the image sensor (1) to the dark current and defective pixel compensation circuit, wherein the dark current and defective pixel compensation circuit (5) includes a storage system, coupled to a processor via a bus, for storing the first data (sensed image data) corresponding to the actual image and second data (dark correction data) corresponding to dark current reference images captured by the image sensor, wherein the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the second data. Please refer 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. What the Harada reference fails to specifically teach is that the storage system stores a plurality of gain conditions and a plurality of exposure times associated with the first data and a plurality of gain conditions and a plurality of exposure times associated with the second data. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54).



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It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the storing of gain and exposure time settings for the first and second data, as taught by Bakhle, with the compensation system of Harada. One would have been motivated to do so because by using a cache of previously stored dark reference images to compensate for actual images, a dark reference image does not need to be captured for each actual image in order to correct for dark current noise, etc., thereby reducing the shutter operations and power constraints, as taught by Bakhle in Col. 3, Lines 44-50.

As for **claim 32**, and the Bakhle reference teaches that the storage system further comprises a memory device (dark image cache 41) coupled to at least one processor (image processing unit 42) via a bus (34), at least one non-volatile memory device (41) coupled to the processor (42) via a bus (34). Please refer to Fig. 2 and Col. 3, Lines 54 – Col. 4, Line 42.

Next, considering **claim 33**, Harada teaches a system comprising an imaging device (digital camera) comprising a storage system for storing first data (sensed image data) corresponding to at least one actual image and second data (dark correction data) corresponding to dark current reference images captured by a pixel array (CCD or CMOS 1), a processor (5) coupled to the storage system for compensating the data corresponding to the actual image. Please refer 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. While Harada does disclose that the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the first (reference) data, Harada fails to teach that that storage system stores a plurality of gain conditions and a plurality of exposure times associated with both the first and second data. Harada further fails to disclose that the system is a computer system comprising a first processor, a memory device coupled to the processor via a bus, and an input/output device coupled to the processor via the peripheral bus. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images)

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are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). Bakhle also teaches a first processor (image processing unit 42), a memory device (41) coupled to the processor via a bus (34), and an input/output device (video camera 30) coupled to the processor. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the storing of gain and exposure time settings for the first and second data, as taught by Bakhle, with the compensation system of Harada. One would have been motivated to do so because by using a cache of previously stored dark reference images to compensate for actual images, a dark reference image does not need to be captured for each actual image in order to correct for dark current noise, etc., thereby reducing the shutter operations and power constraints, as taught by Bakhle in Col. 3, Lines 44-50.

Next, in regard to **claim 36**, Harada teaches a digital camera system comprising an image sensor (1), a dark current and defect pixel compensation circuit (5) for compensating first data corresponding to an actual image (sensed image data), and an image processor (CDS/AGC 2) coupled to the dark current and defective pixel compensation circuit (5) for forwarding the first data from the image sensor (1) to the dark current and defective pixel compensation circuit, wherein the dark current and defective pixel compensation circuit (5) includes a storage system, coupled to a processor via a bus, for storing the first data (sensed image data) corresponding to the actual image and second data (dark correction data) corresponding to dark current reference images captured by the image sensor, wherein the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the second data. Please refer 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. What the Harada reference fails to specifically teach is that the storage system stores a plurality of gain conditions and a plurality of exposure times associated with the first data and a plurality of gain conditions and a plurality of exposure times associated with the second data. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage

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system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the storing of gain and exposure time settings for the first and second data, as taught by Bakhle, with the compensation system of Harada. One would have been motivated to do so because by using a cache of previously stored dark reference images to compensate for actual images, a dark reference image does not need to be captured for each actual image in order to correct for dark current noise, etc., thereby reducing the shutter operations and power constraints, as taught by Bakhle in Col. 3, Lines 44-50.

As for **claim 38**, Harada teaches a system comprising an imaging device (digital camera) comprising a storage system for storing first data (sensed image data) corresponding to at least one actual image and second data (dark correction data) corresponding to dark current reference images captured by a pixel array (CCD or CMOS 1), a processor (5) coupled to the storage system for compensating the data corresponding to the actual image. Please refer 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. While Harada does disclose that the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the first (reference) data, Harada fails to teach that that storage system stores a plurality of gain conditions and a plurality of exposure times associated with both the first and second data. Harada further fails to disclose that the system is a computer system comprising a first processor, a memory device coupled to the processor via a bus, and an input/output device coupled to the processor via the peripheral bus. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). Bakhle also teaches a first processor (image processing unit 42), a memory device (41) coupled to the

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processor via a bus (34), and an input/output device (video camera 30) coupled to the processor. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the storing of gain and exposure time settings for the first and second data, as taught by Bakhle, with the compensation system of Harada. One would have been motivated to do so because by using a cache of previously stored dark reference images to compensate for actual images, a dark reference image does not need to be captured for each actual image in order to correct for dark current noise, etc., thereby reducing the shutter operations and power constraints, as taught by Bakhle in Col. 3, Lines 44-50.

Finally, considering **claim 40**, Harada teaches an integrated circuit comprising a dark current and defect pixel compensation circuit (5) for compensating first data corresponding to an actual image (sensed image data), and an image processor (CDS/AGC 2) coupled to the dark current and defective pixel compensation circuit (5) for forwarding the first data from the image sensor (1) to the dark current and defective pixel compensation circuit, wherein the dark current and defective pixel compensation circuit (5) includes a storage system, coupled to a processor via a bus, for storing the first data (sensed image data) corresponding to the actual image and second data (dark correction data) corresponding to dark current reference images captured by the image sensor, wherein the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the second data. Please refer 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. What the Harada reference fails to specifically teach is that the storage system stores a plurality of gain conditions and a plurality of exposure times associated with the first data and a plurality of gain conditions and a plurality of exposure times associated with the second data. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). It would have been obvious to

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one of ordinary skill in the art at the time the invention was made to have incorporated the storing of gain and exposure time settings for the first and second data, as taught by Bakhle, with the compensation system of Harada. One would have been motivated to do so because by using a cache of previously stored dark reference images to compensate for actual images, a dark reference image does not need to be captured for each actual image in order to correct for dark current noise, etc., thereby reducing the shutter operations and power constraints, as taught by Bakhle in Col. 3, Lines 44-50.

**Claims 5, 13, 34, and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harada (U.S. Pat. 7,133,072) in view of Bakhle et al. (U.S. Pat. 6,061,092) further in view of Takayama et al. (U.S. Pat. 6,683,643).**

Next, in regard to claim 5, the limitations of claim 2 are taught above by Harada in view of Bakhle, and the Bakhle reference teaches in Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54 that a plurality of reference images are captured under a plurality of gain and exposure conditions, and the respective second data corresponding to the plurality of reference images is stored along with the associated gain and exposure condition information (dark column reference data) for each reference image in the storage system (cache 41). What neither reference specifically discloses, though, is that the pixel array captures a plurality of white reference images under a plurality of gain and exposure settings, and the respective second data corresponding to the plurality of white reference images is stored in the storage system together with associated gain and exposure information. However, referring to the Takayama reference, Takayama teaches an apparatus wherein a pixel array (CCD 1) captures a plurality of white reference images (using white test chart), wherein respective second data (black flaw data) corresponding to the white reference images is stored in a storage system (memory 9) (See Fig. 14 and Col. 12, Line 53 – Col. 13, Line 17). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the white reference images of

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Takayama with the storage of reference images based on gain and exposure time settings, as taught by Harada in view of Bakhle. One would have been motivated to do so because it is equally advantageous to detect defect pixels based on white reference images as it is to detect defect pixels based on dark reference images, as pixel defects detected in one method may be missed in another.

Considering **claim 13**, the limitations of claim 8 are taught above by Harada in view of Bakhle, and the Bakhle reference teaches in Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54 that a plurality of reference images are captured under a plurality of gain and exposure conditions, and the respective second data corresponding to the plurality of reference images is stored along with the associated gain and exposure condition information (dark column reference data) for each reference image in the storage system (cache 41). What neither reference specifically discloses, though, is that the pixel array captures a plurality of white reference images under a plurality of gain and exposure settings, and that for each combination of gain conditions and exposure times, the locations of defective pixels which need compensation are identified. However, referring to the Takayama reference, Takayama teaches an apparatus wherein a pixel array (CCD 1) captures a plurality of white reference images (using white test chart), wherein respective second data (black flaw data) corresponding to the white reference images is stored in a storage system (memory 9), thus identifying the locations of defective pixels that need compensation (See Fig. 14 and Col. 12, Line 53 – Col. 13, Line 17).

In regard to **claim 34**, the Harada reference teaches an image processing apparatus (engine 4) comprising a storage system for storing first data (sensed image data in memory 12) corresponding to at least one actual image and second data corresponding to at least one dark current reference image (stored in dark correction memory 23) captured by a pixel array (CMOS or CCD 1), and a processor (image correction circuit 5) coupled to the storage system for compensating the first data (sensed image data) using the second data (dark correction data), wherein the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the second data. Please refer 1, 2, and

6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. What the Harada reference fails to specifically teach is that the storage system stores a plurality of gain conditions and a plurality of exposure times associated with the first data and a plurality of gain conditions and a plurality of exposure times associated with the second data. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col. 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). What both of the above references fail to teach is that the storage system stores data corresponding to dark current reference images and white reference images. However, referring to the Takayama reference, Takayama teaches an apparatus wherein a pixel array (CCD 1) captures a plurality of white reference images (using white test chart), wherein respective second data (black flaw data) corresponding to the white reference images is stored in a storage system (memory 9) (See Fig. 14 and Col. 12, Line 53 – Col. 13, Line 17). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the white reference images of Takayama with the storage of reference images based on gain and exposure time settings, as taught by Harada in view of Bakhle. One would have been motivated to do so because it is equally advantageous to detect defect pixels based on white reference images as it is to detect defect pixels based on dark reference images, as pixel defects detected in one method may be missed in another.

Finally, in regard to **claim 39**, Harada teaches a dark current and defective pixel compensation circuit comprising a storage system for storing first data (sensed image data) corresponding to at least one actual image and second data (dark correction data) corresponding to dark current reference images captured by a pixel array (CCD or CMOS 1), a processor (5) coupled to the storage system for compensating the data corresponding to the actual image. Please refer 1, 2, and 6a, Col. 4, Line 58 – Col. 5, Line 63, and Col. 7, Line 17 – Col. 9, Line 13. While Harada does disclose that the storage section stores a plurality of conditions (e.g. exposure time, amplifier gain, temperature) associated with the first

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(reference) data, Harada fails to teach that that storage system stores a plurality of gain conditions and a plurality of exposure times associated with both the first and second data. Harada further fails to disclose that the circuit comprises a bus, wherein the storage system is coupled to the processor via the bus.

However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). Bakhle also teaches a processor (image processing unit 42) and a storage system (41) coupled to the processor via a bus (34). What both of the above references fail to teach is that the storage system stores data corresponding to dark current reference images and white reference images.

However, referring to the Takayama reference, Takayama teaches an apparatus wherein a pixel array (CCD 1) captures a plurality of white reference images (using white test chart), wherein respective second data (black flaw data) corresponding to the white reference images is stored in a storage system (memory 9) (See Fig. 14 and Col. 12, Line 53 – Col. 13, Line 17). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the white reference images of Takayama with the storage of reference images based on gain and exposure time settings, as taught by Harada in view of Bakhle. One would have been motivated to do so because it is equally advantageous to detect defect pixels based on white reference images as it is to detect defect pixels based on dark reference images, as pixel defects detected in one method may be missed in another.

**Claims 6, 7, 14, 15, 20-24, and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harada (U.S. Pat. 7,133,072) in view of Bakhle et al. (U.S. Pat. 6,061,092) further in view of Takayama et al. (U.S. Pat. 6,683,643), still further in view of Houchin et al. (U.S. Pat. 5,047,861).**

First, considering claim 6, the limitations of claim 5 are taught above, but neither the Harada nor the Bakhle nor the Takayama reference explicitly discloses that the plurality of white reference images



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are captured under a plurality of light conditions and that the second data corresponding to the white reference images is also stored together with an associated light condition. However, the Houchin reference teaches in Col. 8, Line 60 – Col. 9, Line 12 that a plurality of light conditions are used to capture reference images, and therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the reference images under different light conditions, as taught by Houchin, with the reference image capturing if Harada in view of Bakhle further in view of Takayama. One would have been motivated to do so because the plurality of light conditions allows for a far more precise calibration of the reference images than simply two light conditions (e.g. full illumination and zero illumination), thus aiding in the detection of defective pixels under particular conditions.

In regard to **claim 7**, the limitations of claim 6 are set forth above, and the Houchin reference also shows that the plurality of light conditions comprise a no light condition, a first light condition, and a second light condition having a higher Lux value (illumination) than the first light condition. Please refer again to Col. 8, Line 60 – Col. 9, Line 12.

As for **claim 14**, the limitations of claim 8 are taught above, and as is similarly disclosed above with respect to claim 6, neither the Harada nor the Bakhle nor the Takayama reference explicitly discloses that the plurality of white reference images are captured under a plurality of light conditions and that the second data corresponding to the white reference images is also stored together with an associated light condition. However, the Houchin reference teaches in Col. 8, Line 60 – Col. 9, Line 12 that a plurality of light conditions are used to capture reference images, and therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the reference images under different light conditions, as taught by Houchin, with the reference image capturing if Harada in view of Bakhle further in view of Takayama.

Considering **claim 15**, the limitations of claim 14 are set forth above, and the Houchin reference also shows that the plurality of light conditions comprise a no light condition, a first light condition, and a second light condition having a higher Lux value (illumination) than the first light condition. Please refer again to Col. 8, Line 60 – Col. 9, Line 12.

In regard to **claim 20**, Harada in view of Bakhle further in view Takayama and still further in view of Houchin teaches the limitations of claim 14 above, and the Bakhle reference further teaches that the method further comprises selecting one of the reference data by selecting one of the plurality of gain and exposure combinations based on the gain and exposure combination that most closely matches the gain and exposure combination of the second data, as is taught in Figs. 2-3, Col. 3, Line 40 – Col. 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54.

As for **claim 21**, the limitations of claim 20 are taught above, and Takayama also discloses that the method further comprises smoothing the pixels affected by dark current using signal values from available neighboring pixels, the pixels affected being identified using the selected reference data, the signal value of each pixel identified as affected by dark current being retrieved from the second data. Please refer to Col. 14, Lines 30-44 and Col. 15, Lines 5-9.

Regarding **claim 22**, the limitations of claim 21 are taught above, and again in Col. 14, Lines 30-44 and Col. 15, Lines 5-9, the Takayama reference teaches that the smoothing is accomplished by averaging the signal values of the neighboring pixels.

Considering **claim 23**, again the limitations of claim 20 are taught above, and the Takayama reference teaches that the method may further comprise scaling down the signal value of a pixel affected by dark current, the pixels affected being identified using selected reference data, the signal value of each pixel identified as affected by dark current being retrieved from the second data. See Col. 14, Lines 30-44.

In regard to **claim 24**, the limitations of claim 24 are taught above, and Takayama further teaches in Col. 14, Lines 30-44 that the scaling down is accomplished by multiplying the signal value by an average signal value for dark current and hot pixels at the selected gain and exposure combination and dividing by the signal value of the pixels to be compensated.

Finally, regarding **claim 35**, the Harada reference teaches that a storage system stores first data corresponding to an actual image and second data corresponding to a reference image captured by the pixel array, but Takayama fails to disclose that the storage system stores gain conditions and exposure times associated with both the first and second data, wherein the compensation using the second data involves associating the gain and exposure time of the second data that most closely matches the gain and exposure time associated with the first data. However, the Bakhle reference teaches that gain and exposure settings of the first image (scene image) are stored in a storage system (dark image cache 41), and gain and exposure settings of a second image (dark images) are also stored, wherein the gain and exposure time settings of the second data (dark images) used in the compensation are those which most closely match the gain and exposure time settings of the first data (scene image) (Please refer to Figs. 2-3, Col. 3, Line 40 – Col 4, Line 32, and Col. 4, Line 66 – Col. 5, Line 54). What Harada and Bakhle further in view of Takayama both fail to disclose is that the storage system processor further stores light condition information for the second data, but the Houchin reference teaches in Col. 8, Line 60 – Col. 9, Line 12 that a plurality of light conditions are used to capture reference images, and therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the reference images under different light conditions, as taught by Houchin, with the reference image capturing of Harada in view of Bakhle further in view of Takayama. One would have been motivated to do so because the plurality of light conditions allows for a far more precise calibration of the reference images than simply two light conditions (e.g. full illumination and zero illumination), thus aiding in the detection of defective pixels under particular conditions.

**Claims 16-19 and 25-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harada (U.S. Pat. 7,133,072) in view of Bakhle et al. (U.S. Pat. 6,061,092), further in view of Takayama et al. (U.S. Pat. 6,683,643), still further in view of Houchin et al. (U.S. Pat. 5,047,861), and still further in view of Baharav et al. (U.S. Pat. 6,737,625).**

Considering **claims 16-19**, the limitations of claims 14 and 15 are taught above, but none of the Harada, Bakhle, Takayama, nor Houchin references specifically discloses that reference data is created for dark dead pixels, white dead pixels, saturation dead pixels, and bad pixels. However, as the Baharav reference teaches in Col. 1, Lines 43-57, dark dead pixels, white dead pixels, saturation dead pixels, and bad pixels are all common forms of defective pixels, and therefore it would have been obvious to one of ordinary skill in the art to have incorporated the defective pixel compensation method of Harada in view of Bakhle, further in view of Takayama, still further in view of Houchin so as to compensate for dark dead pixels, white dead pixels, saturation dead pixels, and bad pixels. One would have been motivated to do so because correcting for defective pixels using all of the above reference data ensures the highest quality image possible under a variety of image-taking conditions.

Next, as for **claims 25-28**, the limitations of claims 16-19 are taught above, respectively, and while Harada in view of Bakhle, further in view of Takayama, still further in view of Houchin, and still further in view of Baharav does not expressly teach that the dead and bad pixels are scaled in various ways based on different light conditions, Official Notice is hereby taken that it would have been obvious to scale the different types of dead and bad pixels in different ways under different lighting conditions because each type of dead pixel is detected using such different lighting conditions, and thus by scaling the signal value up or down based on the specific type of dead pixel detected, each pixel can be effectively corrected to create an image having few defects.

Finally, regarding **claim 29**, the limitations of claim 28 are shown above, and while none of the reference directly discloses that the method of claim 28 further comprises color compensating bad pixels

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using a formula based on the number of defective colors for the bad pixels, Official Notice is hereby taken that color compensating bad pixels is well-known to those of ordinary skill in the art and would have been advantageous to one of ordinary skill in the art because color compensating bad pixels allows for defective pixels to be corrected to the specific color desired in the scene, as opposed to simply correcting the luminance level of the pixel.


*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gregory V. Madden whose telephone number is 571-272-8128. The examiner can normally be reached on Mon.-Fri. 8AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ngoc Yen Vu can be reached on 571-272-7320. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Gregory Madden  
April 3, 2007

  
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SUPERVISORY PATENT EXAMINER